without splitting. The other three specimens were unaltered. All four specimens were slightly acid to test paper, but the quantity of acid was too small to be determined.

Mareck (*Chem. News*, xlvii. 25, from *Zeitschr. für Anal. Chem.* xxi.), has lately recommended the preservation of caoutchouc tubes, by keeping them in water when not in use. This is, no doubt, efficacious in consequence of the exclusion of air.

Cooper's Hill, January 22 HERBERT MCLEOD

A Possible Cause of the Extinction of the Horses of the Post-Tertiary

A TRAVELLER in the Park region of northern Colorado, and the central portion of Wyoming, fifteen years ago, could not fail to notice the immense numbers of skulls and other bones of bisons in districts at that time no longer frequented by these animals. Scattered specimens were to be seen in all directions, some of them bearing marks of bullet and knife which left no doubt as to the agent of destruction. Others were to be found in numbers in localities which suggested that they had been surprised by death while seeking shelter from the weather rather than the human destroyer. In such cases, tumbled and mixed by the scavengers, they were thickly strewed over small areas, and the contour of the surface often was such as to bring them closer together with the movement of water or soil. When asked the cause of the wholesale slaughter, the reply of the natives was almost invariably "the hunters killed a great many, but the most died in the deep snow and cold weather some twenty-five years ago."

The great losses experienced by the cattle men of the Medicine Bow and Elk Mountain region, only a couple of winters ago, are too recent to have been forgotten. The next spring and summer the unfortunate owner found the carcases of his cattle in positions similar to those occupied by the bands of bisons. In small parties they had huddled in sheltered basins or nooks, and some, upheld by the snow through the winter, were still on their feet. Since then these "bone yards" have become similar in appearance to those of earlier date.

Last summer the kindness of Prof. Agassiz enabled me to make some discoveries in the Mauvaises Terres of the eastern slope of the Rocky Mountains which vividly brought to mind the pockets full of recent skeletons. Sections in the Post-Tertiary beds here and there disclosed groups or herds of fossil horses (*Equus*) in circumstances so similar as to leave no alternative to the conclusion that the same causes had filled the bone basins in the olden and in most recent time.

Stripped of the strata above them, the contour of the surface would have been similar, and the old-time Coyotes in their feasting had evidently brought about an equal amount of confusion in the remains. About the time of the deposition of these fossils the horses became extinct. *Why* is still an open question. Such evidence as was gathered there has led to the belief that, in that region at least, occasional "cold waves" of days—perhaps weeks in duration, which deep snows caused, or were the principal causes of the extermination of the horses. Other causes that may be suggested are these: lack of water, and an extended glacial period. A consideration of the character of the deposits, the drainage of the mountains at the time, the absence in these beds of proof of a glacial period affecting them since, and the continued existence in the same locality of other creatures, somewhat less sensitive to the cold, would seem to be sufficient objections to their acceptance. The tradition of the Indians, that there is a winter of terrible destruction to the animals once or twice in the lifetime of a man—say once in about forty years—appears to be confirmed by the testimony of the whites. A few degrees or a few days added to the measure of the "wave," or "blizzard," and a few inches added to the depth of the snow would suffice to sweep the herds from the pastures. Weather of this character is a possibility every winter in the Bad Lands, though we hardly expect it. Apparently the rocks contain evidence of such weather in post-Tertiary times. And it may not have differed so very much from that we are having to-day. S. GARMAN

Cambridge, Mass., U.S., January 12

Suicide of Scorpions

SPEAKING of scorpion suicide, Mr. G. J. Romanes in his "Animal Intelligence writes: "Still I think that so remarkable a fact unquestionably demands further corroboration before we shall be justified in accepting it unreservedly" (p. 225). Some years ago I made some experiments and observations on a smaller and a larger species of scorpion found on the Cape Peninsula. I am unable to ascertain the specific names; the smaller are found beneath the bark of decaying tree-stumps, the larger, which often weigh upwards of seventy grains, are found beneath stones and ant-balls. I have recently resumed these experiments and observations. The conclusion I come to is that neither of these species have any suicidal instinct. Only in one case have I found, after death, any sign of such a wound as the sting might inflict; in this case, though one of the tergal plates showed a largish irregular fracture, the wound did not seem a fresh one, and was dry and apparently skinned over; in this case, too, though I watched the death of the scorpion (caused by the gradual application of heat to the bottom of the glass vessel in which the creature was inclosed), I was not able to detect anything like the act of suicide. I will now briefly describe the nature of my experiments.

1. Condensing a sun-beam on various parts of the scorpion's body. The creatures always struck with the sting round, across, and over the heated spot, and seemed to try and remove the source of irritation.

2. Heating in a glass bottle. As this admits of most careful watching, I have killed some twenty or thirty individuals in this way. The creatures very commonly pass the sting over the body as if to remove some irritant. The poison exudes from the point of the sting and there coagulates.

3. Surrounding with fire or red hot embers. I first took a newspaper, moistened a ring about a foot in diameter with alcohol, and placed a scorpion within the ring. The paper was, by this fire, ignited. He walked without hesitation through the fire, and tried to make his escape. I made a ring of red-hot wood-embers, and placed a scorpion in the middle. He pushed his way out, displacing two of the embers. I made a better fire-wall, and put him in the middle again. He crept over the embers. I placed him in the midst of a ring of embers on the flat and much-heated stones of the fire-place. He crept over the embers again, but this time got baked before he could escape.

4. Placing in burning alcohol. I placed a layer of an eighth of an inch of alcohol in a shallow vessel, lit the alcohol, and placed the scorpion in the midst of the burning spirit.

5. Placing in concentrated sulphuric acid. I moistened the bottom of a large beaker with a very thin layer of concentrated sulphuric acid, and put in a scorpion. The creature died in about ten minutes. (I have also tried other strong acids, a concentrated solution of sodium hydrate, and a potassium cyanide solution.)

6. Burning phosphorus on the creature's body. I placed a small pellet of phosphorus near the root of the scorpion's tail, and lit the phosphorus with a touch of a heated wire. The creature tried to remove the phosphorus with its sting, carrying away some of the burning material.

7. Drowning in water, alcohol, and ether.

8. Placing in a bottle with a piece of cotton-wool moistened with benzene.

9. Exposing to sudden light. I have not tried special experiments as to this point, but have, on turning over an ant-ball, suddenly exposed a scorpion, hitherto in complete or almost complete darkness, to the full glare of South African sunshine.

10. Treating with a series of electric shocks.

11. General and exasperating courses of worry.

I think it will be admitted that some of these experiments were sufficiently barbarous (the sixth is positively sickening) to induce any scorpion who had the slightest suicidal tendency to find relief in self destruction. I have in all cases repeated the experiments on several individuals. I have in nearly all cases examined the dead scorpion with a lens. My belief is that the efforts made by the scorpion to remove the source of irritation are put down by those who are not accustomed to accurate observation as efforts at self-destruction. On one occasion I called in one of my servants to watch the death of a scorpion by gradually heating it in a glass bottle. The creature at once began moving its sting across and over its back, upon which my servant exclaimed, "See it is stinging itself." I do not wish to imply that all the cases of alleged scorpion suicide are merely instances of careless observation. All I wish to do in this note is to record my individual experience, and to state clearly that after making a series of observations as carefully as I could

on a large number of individuals, I cannot place on record a single instance of clear and unmistakable scorpion suicide.

Rondebosch, January 1 C. LLOYD MORGAN

Mimicry in Moths

I HAVE read with great interest the observations of the Duke of Argyll on Mimicry in Moths. I remember more than one similar occurrence during my travels. The most curious was as follows:—

Whilst in Japan, a messmate brought on board, in an ordinary po, a beautiful trained shrub with a leaf much resembling that of an orange. It was placed on the ward room table where we all sat, the steward removed it from the table to the top of an harmonium at least three times a day, and I watered it when required, and often examined and admired it; in about eight or ten days it began to show signs of failing; and, thinking it might be infected with spider or green fly, I examined it carefully, and in doing so I disturbed a large green smooth-skinned caterpillar. Like all animals on board ship he soon became a great favourite, and we often asked strangers to point him out and in no case did they succeed.

He always lay along the edge of the leaf, with his head to the point and eat at each bite, exactly the breadth necessary to preserve the contour of the leaf as far as possible, when he reached the point, by a few sharp convulsions he returned to the stem and began another row. When he had finished one half of the leaf he began the other; and when nothing but the centre rib of the leaf was left he eat backwards along the stem. He was the most economical feeder I ever saw, only a very little bit of the centre rib of the leaf was bitten off and fell to the ground, and the hard stem of the leaf was left.

I soon observed that he could assume the exact shade of the leaf he was feeding on, and I frequently shifted him and watched the process.

In due time he assumed the chrysalis form; he partly suspended, partly glued, himself to the stem of the plant and it was very difficult to detect him; but not nearly so difficult as in the caterpillar state.

He remained a very short time in the pupa, and one day I was called by a messmate who informed me that "My beastly bug had hatched out," and at first I thought this was the case, as a beautiful black and gold butterfly was expanding his wings and legs on the table, and soon took wing, but was captured and handed over to our bug collector, who by the way took no interest whatever in the prior stages; he was neither butterfly, moth, nor beetle, so nothing to him.

I went to observe how he had broken out of the sheath and was astonished to find that my chrysalis was safe and sound, the butterfly we had certainly did not come from it. Then where did it come from? We were still in Yokohama harbour, and it was a common occurrence that insects flew off to the ships. But how did a butterfly in the state I saw this one get on the ward room table? I came to the conclusion that the pupa had been attached to the plant or pot; I did not anticipate what took place. In a few days another butterfly, to all appearance the brother of the first one, was seen (but not by me), to emerge from the chrysalis we had at first observed; and I have no doubt the first insect had eluded all our prying, and that there were two caterpillars all the time on the plant.

I do not get NATURE until it is a fortnight old, and I have waited with anxiety to see if any one better able than I am would endeavour to show that mere physical causation is sufficient to account for all the phenomena disclosed by the Duke's admirable observation of the moth.

I look upon the Duke as one of the best observers of Nature we have, and his opinions must carry great weight; and believing as I do that in the Theory of Natural Selection the future existence of our race and all hope of advancement in morality is bound up, I am anxious that his doubts on this subject should not carry weight with others.

I think the whole question lies in this—were either of these caterpillars, or the Duke's moth perfect, or even the most perfect of their kind?

I believe I have had more opportunity of observing cases of mimicry than his Grace has, and I have always found that the individuals vary as much in these forms of life as in any other. At Labuan one of the Engineers of the coal works sent a native out and in half an hour he returned with seven leaf-insects. I had picked one up in my walk from the settlement, and although at first each appeared a perfect leaf to my eye, I soon found great differences between the individuals; some being much better specimens than others—just as all sheep are not sheepish to the shepherd—and I think it is quite possible that not one of these eight insects would deceive the eye of an average natural enemy. Let us suppose that anyone of these were so perfect as a mimic, that it would deceive this enemy, it might be wanting in the advantage of perfect rest whilst under inspection, and thus be detected. It was by the movement of the insect that I was enabled to get the one I picked up. The Duke's moth was betrayed by his "beaded eyes and thorax;" and last of all, there was a small hole in the covering of the bright wings, which the Duke considers one of the mysteries of nature, and through all the mimicry of this moth the Duke with very little trouble detects the imposter; as far as he was concerned, all the effort of nature was wasted. If I may be allowed the paradox, it is only when one has come to see what a botch nature has made of its work that its beauties can be properly appreciated. I admire quite as much the quickness of eye that belongs to the lizard that may have been on the watch to capture the moth; these "mysteries" have gone on together; and where a moth or a lizard failed ever so little it went down whilst its better appointed brother was the fittest to survive. Until the mind has taken in how constant the battle is, how small the advantages must be when the enemy is travelling the same path, it is difficult to resist the feeling of wonder and the desire to account for all by a fiat of creation.

I remember some remarks by the Duke of Argyll in a similar strain, when he observed three water-oozels take the water for the first time. He was struck with the way in which they all dived and swam, so perfectly; but I think he failed to consider this view of the matter—did any one of these surpass the others in the art, even were his advantage so little that the Duke was unable to detect it? if so, then provided he was equal of his brothers in all other respects, he was the fittest to survive; and as we evolutionists only claim little by little; its ordinary phrases are no lean and empty formulæ to me.

Nothing but the conviction that, in the new light thrown on nature by Charles Darwin and his numerous disciples, lies the happiness or misery of our race, would have emboldened me, so indifferently educated for the task, to take up the subject and your time. DUNCAN STEWART

Knockrioch, January 25

Clerk-Maxwell on Stress

CAN any of your readers give me a reference to the note in which Maxwell, commenting on or replying to a correspondent of NATURE, gave his ideas as to the nature of stress in a beam or cord? T.

The Comet

MAY I ask space to make some observations about the orbit of the Great Comet of 1882?

Looking on the many elements published in NATURE, in the *Dunecht Circulars*, and in the *Astronomische Nachrichten*, I find very great differences between one and another. Especially the elliptical elements calculated by Mr. S. C. Chandler, Mr. Frisby, Mr. Kreutz, and Mr. Morrison present periods peculiarly different.

Now this fact can be produced but by two causes; either it may be that the different observers considered different parts of the nucleus as the brightest part; or it may be that the movement of the comet has been much perturbed by some bodies of the solar system.

The first hypothesis is very probable, as you remark in the "Astronomical Column" in NATURE, vol. xxvii. p. 300.

The division of the head in two, and perhaps three portions, is a fact well observed by many astronomers, and well shown in the drawings published by Mr. A. A. Common, Dr. Doberck, and Mr. W. T. Sampson in NATURE, vol. xxvii. pp. 109, 129, and 150.

But I observed that with small magnifying power the appearances of the brightest part of the head maintained always a certain unity, which would not admit great mistakes in the observations. Therefore it seems to me that, unless we suppose considerable and unknown variations in the form of the nucleus, only the difference of appreciation of the point observed can hardly explain such a great, and I say regular, difference between one orbit and another.

I say *regular difference*, because I remark a certain peculiarity.